# Instruction Book

No. 8231

# Subway Transformers

GENERAL ELECTRIC COMPANY

SCHENECTADY, N. Y.

NOVEMBER, 1903

TYPE H SUBWAY TRANSFORMER
WITH RELIEF PLUG
(New Design)

# SUBWAY TRANSFORMERS

## THE UNDERGROUND CHAMBER

### Size of Chamber

The underground chamber provided to receive these transformers is usually of brick. In order that the transformers when in operation may not become unduly warm, the chamber must present sufficient wall surface to dissipate the heat generated. In an average case, 8 watts of transformer losses may be allowed for each square foot of wall surface. In moist soil and with a well ventilated chamber as much as 12 watts per square foot may be allowed, while under unfavorable conditions not more than 6 watts per square foot would be permissible. (The total surface including roof and floor should be included when determining wall surface.)

## DRAINAGE

The chamber should be well drained and trapped to the sewer. (See page 8.)

## SIZE OF MANHOLE

The size of the manhole entrance must be determined with reference to the dimensions of the transformers to be admitted. (See pages 13 and 14.)

## INSTALLING THE TRANSFORMER

### Bushings and Cables

Having located the transformer in the desired position, attach the cables by means of the special

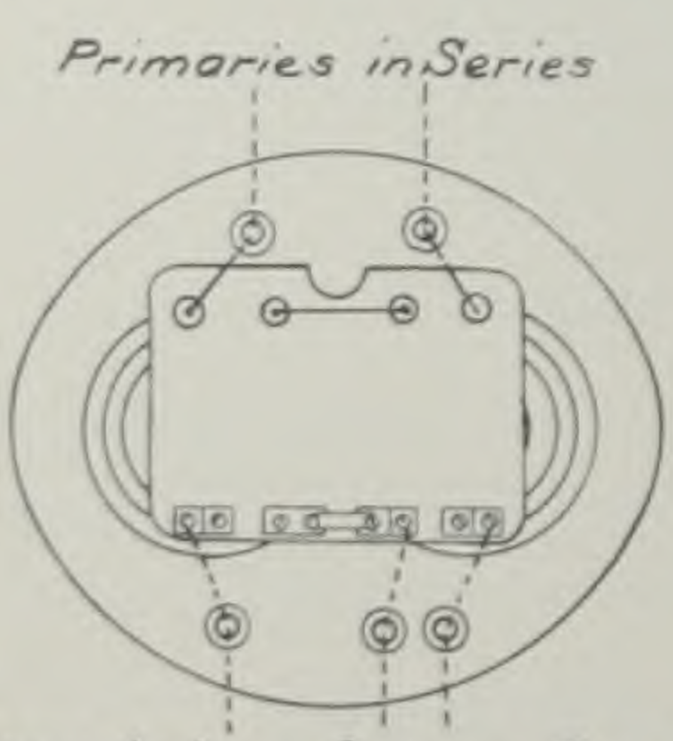
removable, metal bushings provided for this purpose. Each bushing fits a tooled seat on the box, and is held in place by a nut on the inner end of the bushing. A special forked wrench to fit these nuts accompanies each transformer.

The cover of the transformer is first removed, care being taken not to injure the elastic packing between the cover and the box. The metal bushings are then taken from the transformer and each bushing attached to its proper cable by means of a plumber's "wiped joint." The bushings, with the cables, are then returned to their places and screwed home securely by means of a clamping nut. To insure a water-tight joint between the bushing and the box, the special gasket furnished with these bushings must be used.

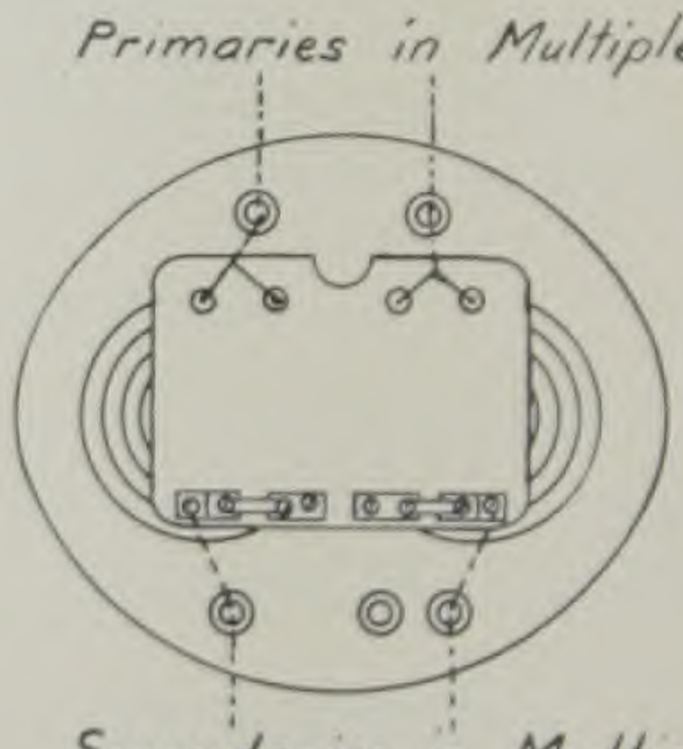
## CONNECTIONS

### Secondary Connections

Three bushings are provided on the secondary side. Within the transformer, four winding terminals are




Secondaries in Series or Three Wire.




Secondaries in Multiple.

attached to the secondary, and by means of coupling straps, also provided, the secondary may be arranged for series, three-wire, or multiple operation as shown in

the foregoing diagrams. If only two secondary cables are employed, the third bushing must be plugged and sealed.

### Primary Connections

The primary side is furnished with two cable bushings. The four leads from the primary winding have terminals by means of which they may be coupled in series or in multiple, according to the customer's requirements. The diagrams on the preceding page show the method of making these connections.

## SAFETY PLUG

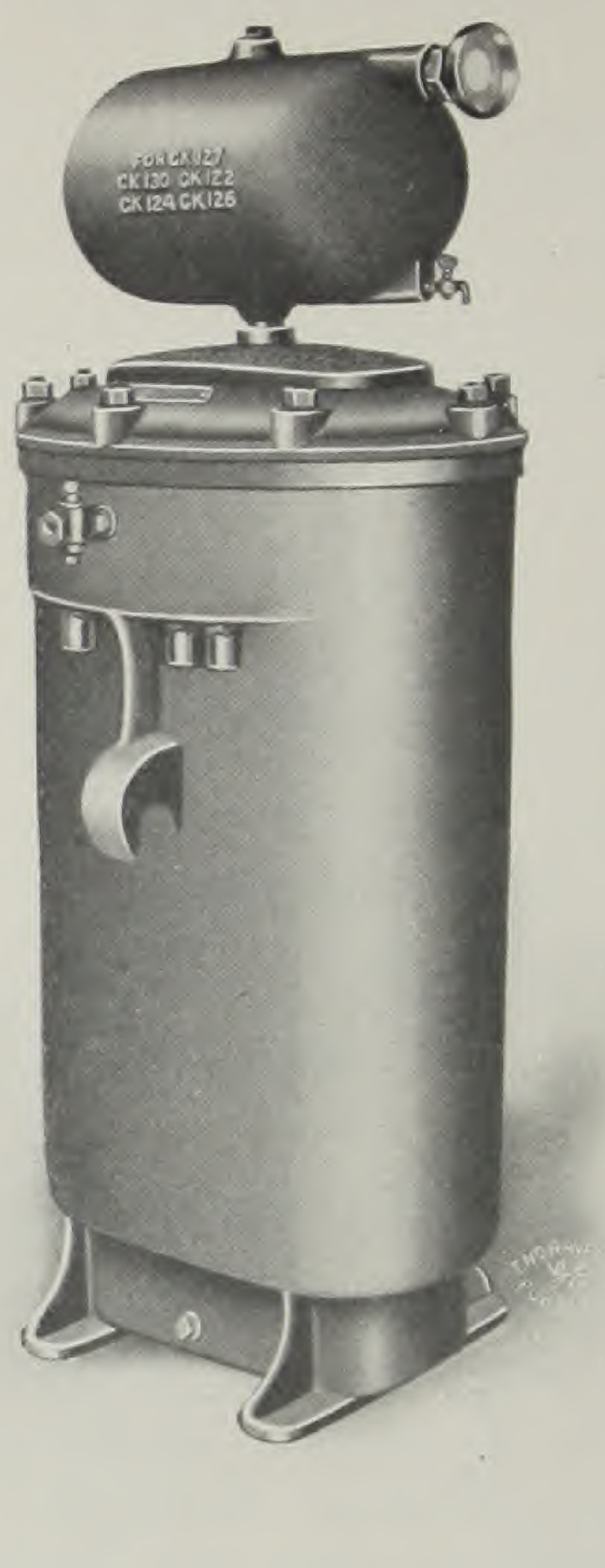
In the event of a short circuit, or other similar accident on the secondary lines, undue pressure might be created within the transformer case. To prevent damage to the transformer case under these circumstances a safety plug is provided, which consists of a thin metal disk mounted in a fitting screwed to the top of the transformer. (See pages 8, 13 and 14.)

## FILLING THE TRANSFORMER

Before filling the transformer, see that the draw-off plug at the bottom of the box is closed, then fill the transformer with oil until it reaches the level of the white line painted around the inside of the box. After filling, replace the cover with the safety plug attached. The transformer will then be ready for operation.

## OLD DESIGN TRANSFORMERS

When employing transformers of large capacity in a manhole having a small entrance, it is sometimes desirable to use transformers of the older design, on




TYPE H SUBWAY TRANSFORMER WITH
EXPANSION CHAMBER
(Old Design)

account of their smaller dimensions. The following features of difference between the two designs are of importance.

In a Type H subway transformer of the older design the oil should completely fill the transformer so as to be in contact with the cover at all times. In order to accommodate the expansion of the oil it is therefore necessary to provide either a closed expansion chamber above the transformer, or a vent pipe. (See pages 6 and 8.)

As the leads are completely submerged in oil special precautions must be taken against creeping of oil into the cables. When installing transformers of the older design the following additional precautions are therefore necessary.

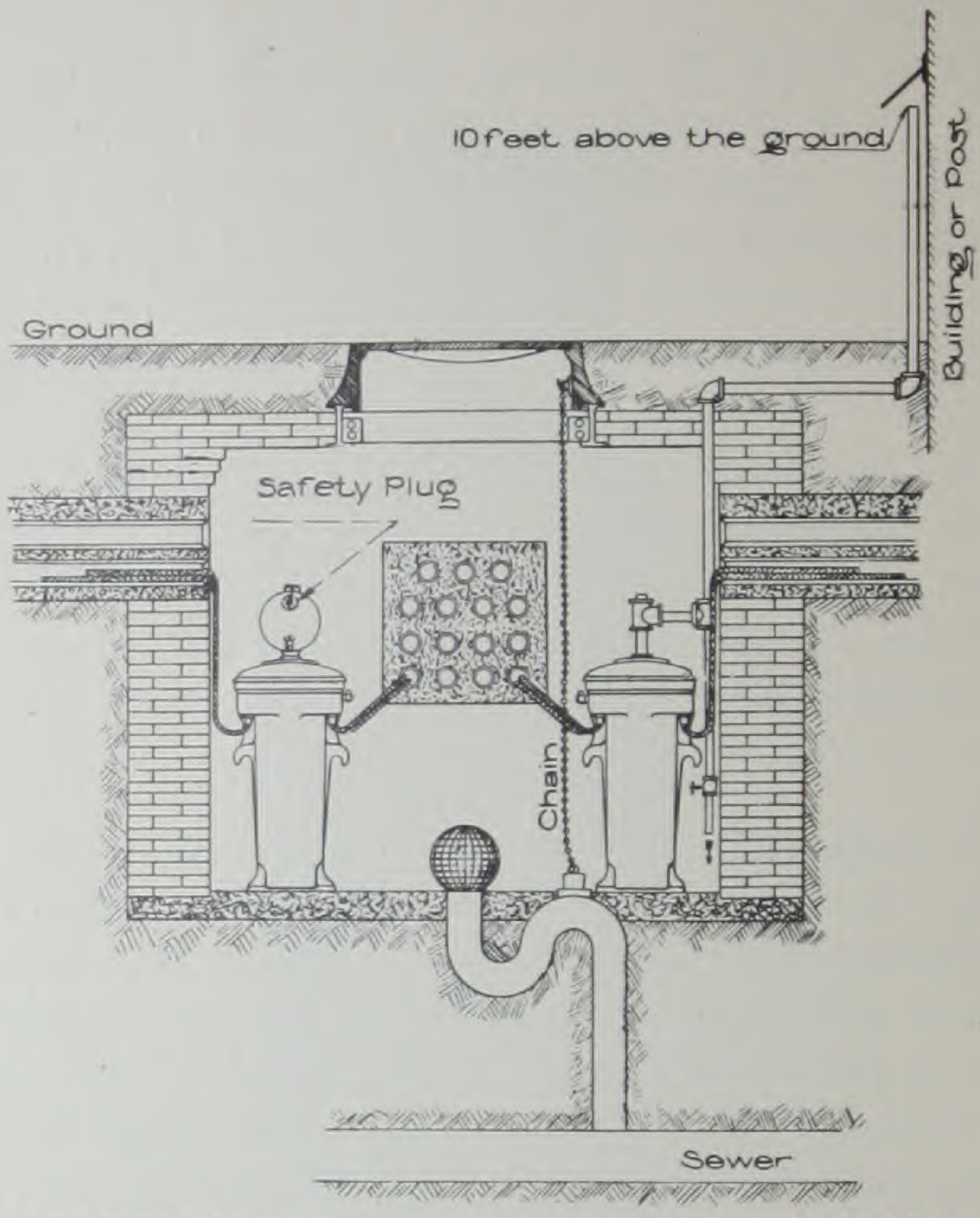
### Expansion Chamber

Transformer oil expands at the rate of approximately 1% for each 20° Fahr. This is provided for in the older style transformers by the use of the expansion chamber consisting of a cast iron reservoir attached to cover of the transformer. When filled in accordance with instructions which follow, the oil is at all times in contact with the cover of the transformer proper, thus utilizing to the best advantage the available cooling surface. As the transformer becomes warm the oil expands into the upper chamber. With this device the pressure within the transformer case under ordinary conditions of operation will never exceed 3 or 4 pounds.

### Vent Pipe System

In some cases, instead of the foregoing method a simple vent pipe attached to the transformer cover is employed. This method is not recommended by the General Electric Company, as, unless installed with

special precautions, trouble will arise due to the entrance of condensed moisture, scale, rust, etc., within the




SECTION OF SUBWAY TRANSFORMER CHAMBER

transformer. In order that a vent pipe may work satisfactorily, the following precautions are necessary:

*First.* The pipe must not be smaller at any point than the tapped hole in the center of the transformer cover.

*Second.* The upper end of the vent pipe must be carried well above the chamber, and should extend vertically at least 8 ft. above ground at the side of a post or building, the upper end being provided with a hood to prevent the entrance of water.

*Third.* It is essential that a drip pipe and draw-off cock be provided as shown, and the accumulated condensation should be drawn off at least once in three months.

### Filling the Transformer

Before filling the transformer, see that both the draw-off plug at the bottom of the box, and the cock in the side of the box just above the bushings are closed; remove the plug from the top of the expansion chamber, and fill the transformer with oil until it reaches the level of the pet cock in the expansion chamber. This pet cock indicates the proper level of the oil when cold. After filling, close the pet cock and replace the plug. The transformer will then be ready for operation.

If desired, the lower part of the transformer box may be filled with oil when the connections are completed, the remainder being added to the level of the pet cock after the cover is bolted in place.

When the vent pipe is employed, sufficient oil should be inserted to completely fill the transformer case and cover.

### Draw-off Cock and Plug

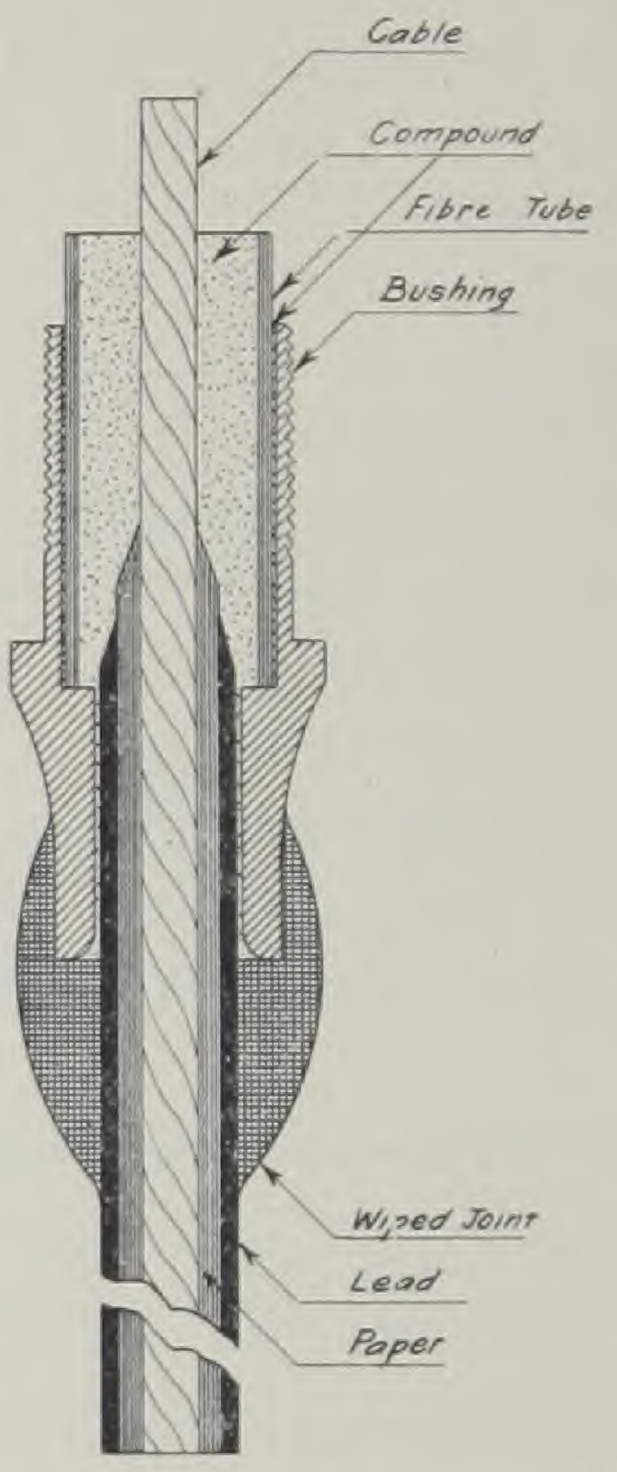
A draw-off cock, set a few inches below the joint between the box and the cover, affords a convenient means for withdrawing sufficient oil before removing the cover. When it is desired to empty the transformer for transportation, the draw-off plug at the lower end of the box is employed.

### Preparation of Cables

Stub leads, 6 ft. long outside the box, are furnished with each transformer, and are sealed into special bushings. The careful preparation of the cable end is

very important in order to prevent siphoning of oil. Cables are prepared in the following manner:

The conductor having been bared for a sufficient distance, the lead covering is cut back one-half inch behind the insulation, which is tapered in towards the bared conductor. The bare, stranded conductor is then cleaned and thoroughly filled with hot solder to prevent




SECTION OF CABLE BUSHING SHOWING METHOD OF SEALING

creeping of the oil. The bushing is next placed on the cable so that the lead covering projects one-half inch above the bottom of the counter-bore. A plumber's "wiped joint" is then made between the lower end of the bushing and the lead covering. The upper end of the bushing is then filled in with hot

compound. While still hot, the fiber insulating tube is placed between the cable and the bushing and pressed down to the bottom of the counter-bore, after which additional compound is inserted to fill the fiber tube. The cable terminals are then attached to the inner end of the lead. A section of a bushing, showing the method of sealing the cable, is shown in the illustration on the opposite page. The outer end of the lead is sealed over before shipment in order to prevent absorption of moisture by the paper insulation.

### Attaching the Cables

The free end of the stub lead should be connected to the cables in the regular way, care being taken to make a good electrical joint and to prevent any moisture reaching the insulation. The joint should be thoroughly insulated and covered by a lead sleeve, which should be joined by a plumber's "wiped joint" to both the stub lead and cable proper.

## GENERAL REMARKS

In order to obtain satisfactory operation, the following points must be carefully observed:

Be sure that the transformer is filled with oil to the proper level. Oil gauge glasses can be provided when specially ordered, for the largest sizes of old style transformers only.

Make all joints tight; the presence of water within the transformer case may be fatal to the apparatus.

Examine the safety plug after installing, and at intervals subsequently, and ascertain if the diaphragm is intact. A transformer should never be operated with a broken diaphragm.

# LIST OF TYPE H LOW FREQUENCY SUBWAY TRANSFORMERS

## NEW DESIGN

| WATTS | CAT. NOS. | | |
|---|---|---|---|
| VOLTS PRIMARY | 1040-2080 | 1040-2080 | 1200-2400 |
| VOLTSSECONDARY | 104-208 | 115-230 | 120-240 |
| 5000 | 31511 | 31520 | 31529 |
| 7500 | 31512 | 31521 | 31530 |
| 10000 | 31513 | 31522 | 31531 |
| 15000 | 31514 | 31523 | 31532 |
| 20000 | 31515 | 31524 | 31533 |
| 25000 | 31516 | 31525 | 31534 |
| 30000 | 31517 | 31526 | 31535 |
| 40000 | 31518 | 31527 | 31536 |
| 50000 | 31519 | 31528 | 31537 |

## OLD DESIGN

| | | | |
|---|---|---|---|
| 25000 | 31538 | 31541 | 31544 |
| 30000 | 31539 | 31542 | 31545 |
| 40000 | 31540 | 31543 | 31546 |

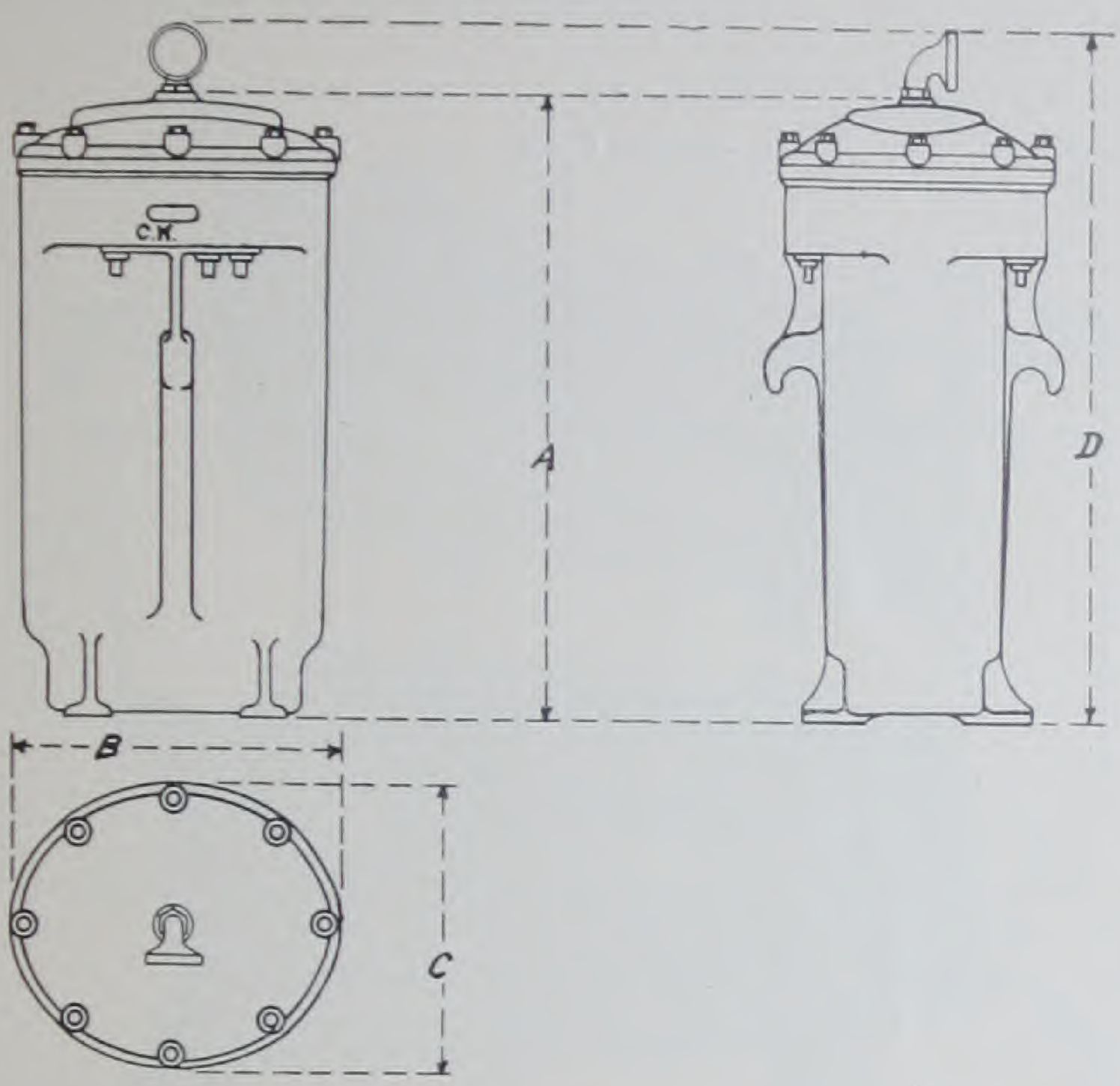
Any transformer in the above list may be re-connected for one-half its rated primary voltages. See paragraph "Primary Connections," page 5.

Following is a list of bushings used in Type H Subway Transformers with the maximum size of standard paper-covered leaded cables having $\frac{4}{32}$" paper which each will accommodate:

| BUSHING SYMBOL | BORE OF BUSHING IN INCHES | SIZE OF CABLE | |
|---|---|---|---|
| BE-1 | $\frac{17}{32}$ | 10 | B.&S. |
| BE-2 | $\frac{21}{32}$ | 4 | B.&S. |
| BE-3 | $\frac{3}{4}$ | 2 | B.&S. |
| BE-6 | 1 | 000 | B.&S. |
| BE-9 | $1\frac{1}{4}$ | 400,000 | C.M. |
| BE-7 | $1\frac{13}{32}$ | 500,000 | C.M. |
| BE-8 | $1\frac{1}{2}$ | 750,000 | C.M. |

# DIMENSIONS OF TYPE H SUBWAY TRANSFORMERS

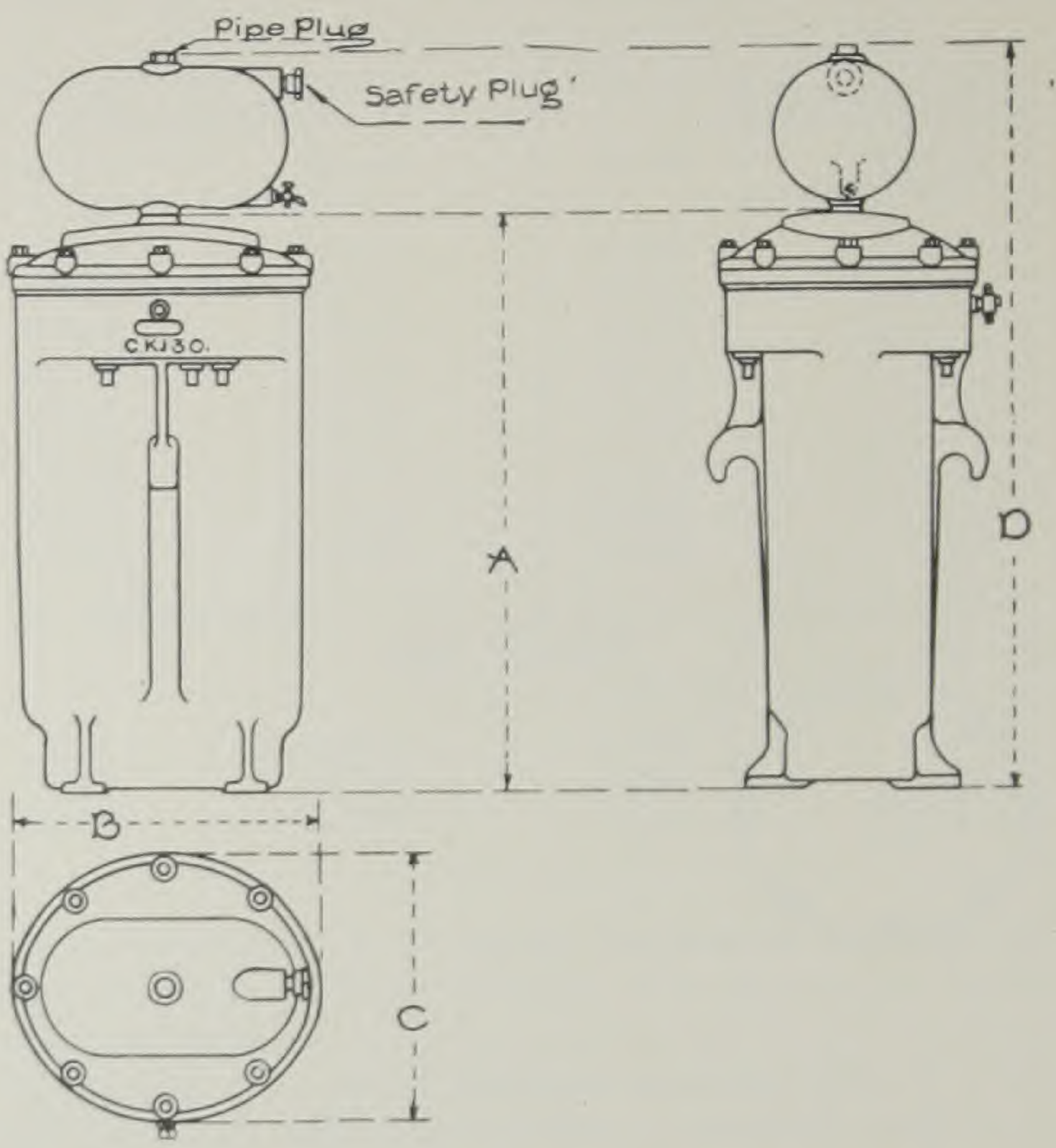
## NEW DESIGN




| Kw. Cap | Box Symbol | DIMENSIONS IN INCHES | | | | Weight in Lbs. | Qts. of Oil | BUSHING SYMBOL | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | | | Pri. | Sec. |
| 5 | CK-121 | $23\frac{3}{8}$ | $17\frac{3}{4}$ | $17\frac{3}{4}$ | $27\frac{5}{8}$ | 370 | 17 | BE-1 | BE-3 |
| 7.5 | CK-125 | $29\frac{5}{8}$ | $18\frac{3}{4}$ | 17 | $33\frac{7}{8}$ | 565 | 30 | BE-1 | BE-6 |
| 10 | CK-125 | $29\frac{5}{8}$ | $18\frac{3}{4}$ | 17 | $33\frac{7}{8}$ | 565 | 30 | BE-2 | BE-6 |
| 15 | CK-177 | $34\frac{1}{2}$ | $21\frac{1}{2}$ | 20 | $38\frac{3}{4}$ | 750 | 50 | BE-2 | BE-9 |
| 20 | CK-180 | $38\frac{3}{4}$ | $23\frac{1}{4}$ | $22\frac{7}{8}$ | 43 | 925 | 70 | BE-2 | BE-9 |
| 25 | CK-182 | $35\frac{5}{8}$ | $27\frac{3}{4}$ | 24 | $39\frac{7}{8}$ | 1000 | 80 | BE-3 | BE-9 |
| 30 | CK-184 | $37\frac{1}{8}$ | $29\frac{1}{8}$ | $25\frac{1}{2}$ | $41\frac{3}{8}$ | 1125 | 96 | BE-3 | BE-9 |
| 40 | CK-186 | $40\frac{1}{2}$ | $30\frac{1}{4}$ | 27 | $44\frac{3}{4}$ | 1325 | 112 | BE-3 | BE-7 |
| 50 | CK-190 | $43\frac{1}{2}$ | $29\frac{3}{4}$ | $28\frac{1}{4}$ | $47\frac{3}{4}$ | 1680 | 144 | BE-3 | BE-8 |

# DIMENSIONS OF TYPE H SUBWAY TRANSFORMERS

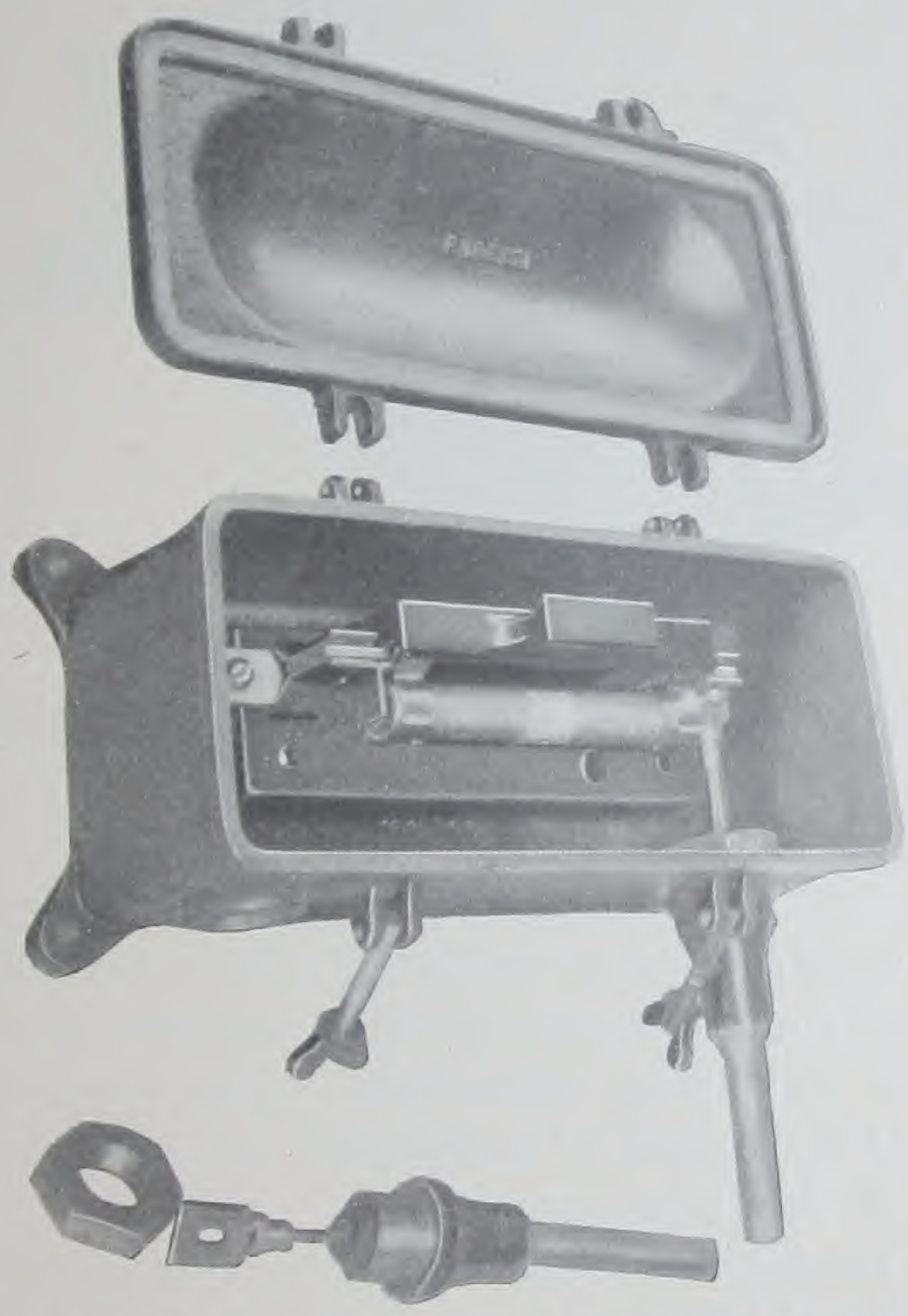
## OLD DESIGN




| Kw. Cap. | Box Symbol | DIMENSIONS IN INCHES | | | | Weight in Lbs. | Qts. of Oil | BUSHING SYMBOL | |
|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | | | Pri. | Sec. |
| 25 | CK-132 | 45¾ | 22¼ | 19 9/16 | 57⅛ | 1270 | 93 | BE-3 | BE-6 |
| 30 | CK-134 | 49½ | 22¾ | 19 9/16 | 60⅝ | 1575 | 100 | BE-3 | BE-6 |
| 40 | CK-136 | 54½ | 23⅝ | 22 1/16 | 65⅝ | 1870 | 112 | BE-3 | BE-6 |

## PRIMARY CUT-OUTS

If cut-outs are desired, the primary fuse box shown in the accompanying illustrations should be ordered. Two are required for each transformer.

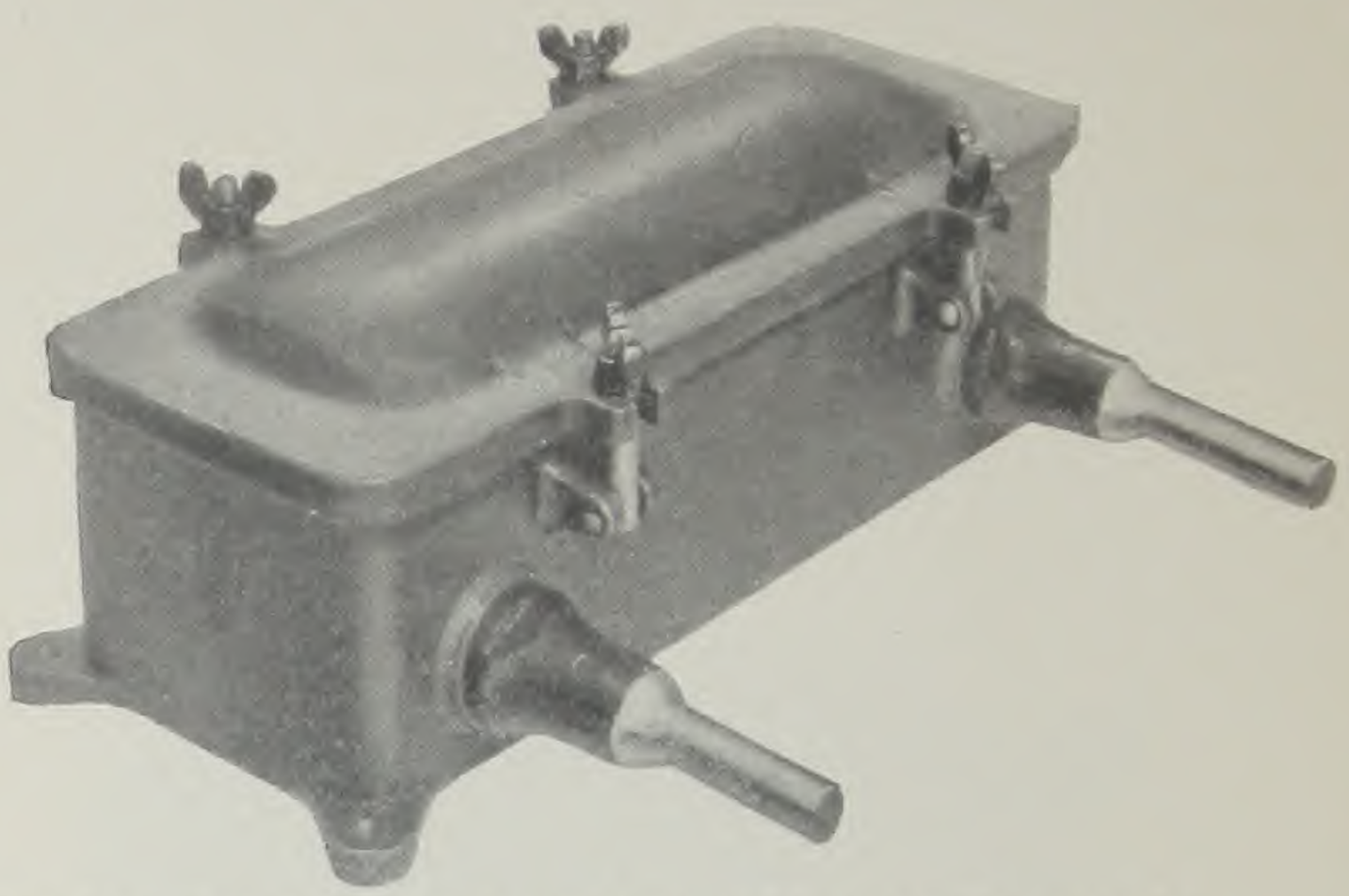


PRIMARY FUSE BOX FOR SUBWAY TRANSFORMER

Interior

The fuse is enclosed in a water-tight cast iron box provided with lugs by which it may be conveniently attached to the wall.

The lead-covered cables should be connected to the metal bushings by means of wiped joints and the counter-bore in the bushing should be filled with compound as outlined for the transformer bushings.



PRIMARY FUSE BOX FOR SUBWAY TRANSFORMER

Exterior

The bushings furnished with the fuse box are the same in construction as those furnished for the transformer and should be set up with washers in order to insure the box being water-tight. The cover is made water-tight by means of a moulded soft rubber gasket as shown in the illustration.

The catalogue numbers of these fuse boxes and of the fuses for the various sizes of transformers are given in the following table:

# CATALOGUE NUMBERS OF PRIMARY CUT-OUTS

| KW. CAPACITY | CATALOGUE NUMBERS | | |
|---|---|---|---|
| | Fuse Box | Fuses | |
| | | 1040 V. | 2080 V. |
| 5.0 | 27457 | 27461 | 27460 |
| 7.5 | 27457 | 27462 | 27461 |
| 10.0 | 27458 | 27463 | 27461 |
| 15.0 | 27458 | 27465 | 27462 |
| 20.0 | 27458 | 27466 | 27463 |
| 25.0 | 27459 | 27467 | 27464 |
| 30.0 | 27459 | 27468 | 27465 |
| 40.0 | 27459 | | 27466 |
| 40.0 | 29306 | 29307 | |
| 50.0 | 27459 | | 27467 |
| 50.0 | 29306 | 29308 | |

# GENERAL ELECTRIC COMPANY

PRINCIPAL OFFICES, SCHENECTADY, N. Y.

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